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Dangerous Dealings: North Korea's Nuclear Capabilities and the
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Dangerous Dealings: North Korea's Nuclear Capabilities and the Threat of Export to Iran

[Siegfried S. Hecker and William Liou](#)

On Oct. 9, 2006, North Korea conducted a nuclear test and proclaimed itself a world nuclear power. The explosion yield was less than one kiloton, much less than the first nuclear test of other states and even less than the expected yield of four kilotons that North Korean officials forecast to their Chinese counterparts.

Nonetheless, the test demonstrated Pyongyang's mastery of the nuclear fuel cycle and at least rudimentary nuclear-weapon design and manufacturing capabilities.

On Feb. 13, North Korea signed a six-party agreement to take initial actions to implement a Sept. 19, 2005 Joint Statement for the eventual abandonment of its nuclear weapons program. While this is welcome news, the road to the abandonment of North Korean nuclear weapons and capabilities will be long and arduous, and success is far from guaranteed. Its nuclear program still poses significant risks to international security, the most serious of which is

the export of nuclear materials, expertise or technologies to states such as Iran and the potential for subsequent proliferation to terrorists.

It was clear by 1994 when Pyongyang signed the Agreed Framework^[1] with the United States that North Korea had mastered the basic technologies required to produce and separate plutonium, which has subsequently formed the centerpiece of its nuclear weapons program. Experts have estimated that North Korea could have produced and separated nearly 10 kilograms of weapons-grade plutonium by then, although they have acknowledged very large uncertainties in that estimate.^[2] Moreover, the 8,000 spent fuel rods that were then stored in a spent fuel pool contained roughly an additional 25 kilograms of plutonium.

The Agreed Framework froze all but maintenance activities at North Korea's Yongbyon nuclear complex from 1994 to the end of 2002. In December 2002, following a political altercation with the United States over accusations of conducting a covert uranium-enrichment program and subsequent suspension of U.S. heavy fuel oil shipments, North Korea expelled International Atomic Energy Agency (IAEA) inspectors. In January 2003, it announced its withdrawal from the nuclear Nonproliferation Treaty and restarted its five-megawatt (electric capacity) nuclear reactor to strengthen its "deterrent" by reprocessing plutonium from the spent fuel stored since 1994.

Since the demise of the Agreed Framework, it has been difficult to assess developments in North Korea's nuclear program. International access to Yongbyon, which reportedly employs about 3,000 scientists, engineers, and research personnel alone,^[3] has been essentially terminated. However, one of the authors (Hecker) had the opportunity to visit Yongbyon in January 2004 and held additional discussions with its technical leadership in Pyongyang in August 2005 and November 2006.^[4] This assessment of North Korea's technical capabilities is based on open literature augmented by what was learned during these visits.

Nuclear Fuel-Cycle Capabilities

North Korea's nuclear program began with a 1959 nuclear

cooperation agreement with the Soviet Union. That pact led to the construction of the nuclear research facilities at Yongbyon, the training of North Korean scientists and engineers, and geological surveys that ultimately discovered large deposits of uranium ore and graphite in North Korea.[\[5\]](#) Although the Soviets did not intend for this help to assist Pyongyang's development of nuclear weapons, it allowed North Korea to master the plutonium fuel cycle.

Nuclear Reactors

In the 1960s, the Soviet Union supplied North Korea with its first reactor, a small IRT-2000 research reactor fueled by highly enriched uranium (HEU), along with a small hot-cell facility for isotope production. Today, this reactor is used sparingly for medical isotope production because Pyongyang has not been able to acquire fresh fuel since the demise of the Soviet Union.

By 1980, North Korea had launched an ambitious program of reactor construction to build a national nuclear power industry. The program called for the indigenous design and construction of three gas-cooled, graphite-moderated, natural uranium-fueled reactors: a small five-megawatt research reactor and a larger 50-megawatt prototype power reactor at Yongbyon and a full-scale 200-megawatt power reactor at Taechon.

These electric reactors were patterned after the British Magnox reactor, the first of which was built at Calder Hall 50 years ago. Experience in the United Kingdom and in France showed that this type of reactor is inferior to light-water reactors (LWRs) for generating electricity but is well suited for producing weapons-grade plutonium because these reactors use natural uranium fuel. Also, the graphite-moderated reactors do not require uranium enrichment, for which much of the materials, equipment, and technology would have to be imported, allowing North Korea to build a self-sufficient, indigenous nuclear program and to produce plutonium fuel for bombs. (Pyongyang eventually realized that LWRs are better power reactors and began to negotiate for Soviet LWRs in 1985.)

By 1994 the five-megawatt reactor was operating and producing approximately six kilograms of weapons-grade plutonium, or

roughly one bomb's worth, per year. North Korea claimed that the 50-megawatt reactor was within one year of operation and that construction of the 200-megawatt reactor had begun but was still several years from operation. These reactors, when fully operational, could produce nearly 60 kilograms and 240 kilograms of plutonium per year, respectively.

Following the breakdown of the Agreed Framework, the five-megawatt reactor was loaded with new fuel and restarted operations in February 2003. It was most likely unloaded and reloaded between April and June 2005 and has been operating since then. Apparently, fuel cladding problems have limited full-scale operations during the past year. If this reactor is not shut down as part of the six-party agreement, then the current load of fuel can remain in the reactor for several more years; the projected plutonium production would be at most six kilograms per year. New fuel would have to be fabricated to continue reactor operations beyond that time.

Construction of the 50-megawatt reactor was halted during the Agreed Framework. During the January 2004 visit, the exterior of the reactor building appeared to be in a poor state of repair. During the August 2005 visit, our delegation was told that North Korea had completed a design study that concluded that construction of the reactor could continue on its original site using much of the original equipment and that the workers were ready to return to the reactor construction site. The delegation was also told that the core of the reactor and other components were not at the Yongbyon site. During the most recent visit, we were informed that little progress had been made at the 50-megawatt-reactor site. Difficulties were encountered in recovering the original state of the equipment. The main problems were not at Yongbyon, but rather in the preparation by other industries and the recovery in other factories. North Korean officials also told us that the recovery job will be more difficult and will take longer because it is difficult to import materials and equipment.

Nothing has been done at the construction site for the 200-megawatt reactor since 1994. Future plans are still being evaluated, but North Korean officials noted that it is most likely less expensive to start over than to continue at the current site.

If the five-megawatt reactor continues to operate over the next few years, it will increase North Korea's plutonium inventory at most by one bomb's worth of material per year and, hence, will not change North Korea's nuclear capabilities dramatically. Completion of the 50-megawatt reactor, however, would greatly enhance Pyongyang's nuclear capabilities because of the roughly tenfold increase in plutonium production. Such an increase would give North Korea much greater flexibility to test weapon designs, increase the size of its nuclear arsenal, and more aggressively consider the export of plutonium. It is also possible that North Korea could make its substantial experience in reactor design and operations available to states with nuclear fuel-cycle aspirations.

Front End of the Nuclear Fuel Cycle

In the 1980s, North Korea began building the requisite facilities to provide fuel for its reactor program. Geological surveys performed by the Soviet Union demonstrated that North Korea had substantial uranium deposits and led to large-scale uranium mining operations in the late 1970s or early 1980s. By the early 1990s, it was estimated that the facilities could produce approximately 300 metric tons of yellow cake (an impure mixture of uranium oxides) per year, which would require approximately 30,000 metric tons of raw uranium ore.

Between 1980 and 1985, a fuel fabrication facility was completed at Yongbyon to refine the yellow cake and produce uranium metal fuel elements for its reactors. In 1992, North Korean officials claimed that the factory was capable of producing up to 300 metric tons of uranium fuel per year. To put these figures in perspective, the five-megawatt reactor requires some 50 metric tons of uranium fuel for one complete reactor core, while the 50-megawatt and 200-megawatt reactors require about 400 and 1,400 metric tons, respectively.^[6] To produce uranium metal fuel for its reactors, North Korea developed extensive engineering, chemical, and metallurgical capabilities. These included the ability to conduct the required uranium separations, purification, and conversion to oxide and metal, as well as the casting and machining of the fuel.

Although routine maintenance of the fuel fabrication facility was allowed during the Agreed Framework, parts of the facility

deteriorated badly during this time. Our delegation was told that some equipment had corroded and collapsed. The director of the Yongbyon facility expected refurbishment of the facility to be completed and fuel fabrication to resume in 2007. He stated that in 1994, two complete loads and a partial load of clad fuel rods were available for the five-megawatt reactor. He claimed that the two complete loads were used during the February 2003 and June 2005 reloading operations. Hence, only partial reloading of the reactor is possible until fuel fabrication resumes. Although some fuel had been fabricated for the 50-megawatt reactor, operating this reactor, if it is completed, also will require the refurbishment of the fuel fabrication facility.

Virtually all aspects of North Korea's fuel production capabilities pose an export threat. The uranium ore deposits are a valuable commodity for any potential nuclear reactor or weapons operation. The uranium mining, milling, separations, purification, and conversion facilities can produce uranium oxide or metal fuel for reactor operations. To produce uranium metal fuel for its plutonium producing reactors, North Korea developed facilities that bring it within one step of producing uranium hexafluoride, the key feed material for centrifuge enrichment. Such enrichment can produce HEU, which like plutonium can be used as a fissile material in nuclear weapons.

During inspections of the fuel fabrication facility prior to 2003, IAEA inspectors found no signs of fluorination equipment that would be needed to make uranium hexafluoride. Yet, there is no question that North Korea has the technical ability to do so. In spite of denials by North Korean officials, Pyongyang quite certainly has an enrichment effort. North Korea made several attempts in the late 1990s and early in this decade to purchase key materials required for a centrifuge program.^[7] Pakistan's president, General Pervez Musharraf, revealed that the Abdul Qadeer Khan network sold centrifuge parts to North Korea for its uranium-enrichment program.^[8] Also, when Libya declared its nuclear program in 2004, one of the recovered containers of uranium hexafluoride appeared to be traceable to North Korea. Our judgment is that Pyongyang's enrichment program is still at the research and development stage and poses little threat of additional weapons capability or export of

HEU at this time. Its fuel fabrication capabilities, however, would allow it to supply the key feedstock, namely natural uranium hexafluoride.

In addition, North Korean technical specialists have developed extensive uranium-metallurgy capabilities for uranium metal-alloy fuel fabrication. North Korea's capabilities to produce, alloy, cast, and machine metal and to protect surfaces are all extremely valuable commodities to states or groups interested in producing nuclear weapons using HEU. These specialists have the type of hands-on practical experience that one cannot learn from the open literature.

Back End of the Nuclear Fuel Cycle

During the 1980s, North Korea also began building the requisite facilities for the back end of the nuclear fuel cycle, the reprocessing of spent fuel to extract plutonium produced in the uranium-238 fuel and to manage nuclear waste from spent fuel processing. Initial experience with processing spent fuel to extract valuable isotopes was gained in the small Soviet-supplied hot-cell facilities at the IRT-2000 reactor site. In 1984, North Korea began construction of an industrial-scale reprocessing facility, called the Radiochemical Laboratory, at Yongbyon to separate plutonium from spent nuclear fuel. Reprocessing, rather than a once-through nuclear fuel cycle, is preferred for spent fuel from this type of reactor because of the difficulty of safely storing the magnesium alloy-clad spent fuel.

IAEA inspectors found the Radiochemical Laboratory operational during their visits from 1992 to 1994. The facility had a nominal capacity for reprocessing roughly 220 to 250 metric tons of spent fuel per year when operated continuously for 300 days, which is more than sufficient capacity to reprocess all of the spent fuel from the five-megawatt and 50-megawatt reactors. Its operation was also frozen, except for maintenance, during the Agreed Framework.

During the January 2004 visit, North Korean officials escorted the delegation through parts of the facility and showed us a sample of the extracted plutonium-metal product. In August 2005, North Korean officials claimed the facility's throughput was increased by 30 percent by replacing some troublesome mixer-settler boxes with

pulsed columns. The Yongbyon technical leadership told us that they had conducted two reprocessing campaigns. The first, in 2003, reprocessed the 8,000 spent fuel rods that had been stored in the spent fuel pool during the Agreed Framework. The second, in the summer of 2005, extracted plutonium from the reactor campaign of February 2003 to March 2005.

Our estimates are that North Korea extracted approximately 25 kilograms of weapons-grade plutonium in the first campaign and 12 to 14 kilograms in the second campaign. These quantities, combined with the best estimate of 8.4 kilograms of plutonium produced and extracted prior to the Agreed Framework, gave North Korea approximately 40 to 50 kilograms of weapons-grade plutonium, sufficient for roughly six to eight bombs, before its Oct. 9, 2006, nuclear test. Although this amount of plutonium is rather modest, it represents the most serious export threat.

The rest of North Korea's back-end fuel-cycle capabilities pose less of an export threat than its front-end capabilities. Although North Korean specialists have all the requisite technical know-how, it is more difficult to build reprocessing facilities and to hide them than it is to build front-end capabilities. Nevertheless, the capabilities to handle spent fuel and extract plutonium could be useful to Iran once it completes its heavy-water reactor at Arak and produces plutonium. This technical expertise could also prove useful to groups that may have designs to extract plutonium from spent fuel being stored in many locations around the world. Although most of this fuel is physically secured and is dangerous to handle because the fission products emit deeply penetrating radiation, it nevertheless represents a potential threat.

Nuclear Weapons

Although North Korea has mastered the full nuclear fuel cycle, it is less clear how much progress it has made in nuclear weapons design, manufacture, and deployment. Although the actual explosion yield of the Oct. 9, 2006, test was less than one kiloton instead of the predicted four kilotons, North Korean specialists most likely learned enough to field a large, simple design with several times that explosion yield. For comparison, the Nagasaki device produced an

explosion yield of 21 kilotons. It is also very likely that Pyongyang is trying to develop more sophisticated, smaller, and lighter designs that are capable of being deployed on a missile. Yet, with the limited nuclear test success and the mixed results of its July 5, 2006, missile tests, it is unlikely that North Korean officials have adequate confidence to launch a nuclear device on one of their missiles unless they feel the regime is faced with certain destruction.

All available evidence suggests North Korea's current nuclear arsenal is small and of limited utility. The size of the arsenal is limited by the plutonium inventory, which we estimate is sufficient for roughly six to eight bombs. The sophistication of its arsenal is limited by its single, not fully successful nuclear test. The likely large size and lack of sophistication of their nuclear devices limit delivery means to aircraft, boat, or van. Preparedness for a potential war-fighting role is limited by safety concerns inherent in an assembled nuclear device. In discussions with North Korean military and political officials, however, Hecker found little recognition of the safety hazards posed by primitive nuclear bombs. Also, not surprisingly, there was rather little indication of a nuclear doctrine or war-fighting strategy.

Consequently, the North Korean nuclear arsenal appears to pose a limited direct threat. In addition to the technical issues just presented, the likelihood of U.S. retaliation and subsequent regime change represent a strong deterrent against the use of its nuclear arsenal. Nevertheless, one cannot rule out potential use by North Korea against U.S. assets or allies as an act of desperation. The threat may also increase in the event of a leadership succession struggle or during political turmoil. We also expect there to be a strong deterrent against North Korea "outsourcing" the delivery of a nuclear weapon to subnational groups such as al Qaeda. Pyongyang would surely be reluctant to give up control of any of its weapons, and it would face certain retaliation from the victim country because attribution of such a device to North Korea is very likely.[\[9\]](#)

Still, outsourcing also cannot be ruled out completely in a desperate situation. The history of the Khan network should serve as a reminder that even when governments have strong incentives not to engage in proliferation activities, some powerful individuals inside

their bureaucracy may take matters into their own hands.

Therefore, although North Korea's nuclear arsenal may not pose a great direct threat to its neighbors or the United States, Pyongyang has apparently accomplished what it cites as the justification for its arsenal: to deter the United States from attacking it. However limited the direct threat of its arsenal may be, Pyongyang has used its indirect leverage with great diplomatic skill. It has been able to keep the United States and the four neighboring states at bay while slowly but surely building up its arsenal. And now it appears that North Korea may be ready to bargain away that arsenal and its nuclear program for economic assistance and normalized relations with the United States.

There is no indication North Korea received weapon-related assistance from China or Russia. Its plutonium-weapon design appears to be indigenous, although it may have received HEU-weapon design information from Khan, perhaps as part of a missile-for-nuclear barter agreement in the late 1990s.[\[10\]](#) Khan sold blueprints of what is reported to be a Chinese HEU implosion weapon design to Libya, complete with step-by-step assembly instructions.[\[11\]](#) It has been reported that U.S. intelligence believes similar information was provided to North Korea.[\[12\]](#) Although North Korea's weapons are plutonium based, the Khan information would still allow North Korean scientists and engineers to compare their work in implosion design with a design that has been tested. Any test data they may have received could help validate their computational models and increase their confidence in the viability of a more-sophisticated plutonium design. In addition, should North Korea develop its enrichment capabilities to the point of producing weapon quantities of HEU, the design information would be very useful.

The direct threat from the North Korean arsenal would increase greatly if Pyongyang finished the construction of its 50-megawatt reactor and scaled up its plutonium production or if North Korea conducted additional nuclear tests. These actions would enhance both the number and sophistication of its weapons. Currently, the threat of exporting nuclear weapons design, manufacturing, and testing skills is less than that posed by exporting its fuel cycle skills

because North Korea has much less experience and limited success with its weapons. Also, exporting fuel cycle skills is more difficult to prevent because these skills can be marketed for civilian nuclear programs, whereas those for nuclear weapons cannot. Nevertheless, North Korean expertise with high explosives, non-nuclear explosive testing, underground tunneling and testing, computational skills, and plutonium metallurgy and fabrication skills are all marketable talents.

Threat of Nuclear Export

In spite of UN Security Council condemnation and sanctions of North Korea's missile tests and nuclear test, Pyongyang has continued its nuclear weapons program. It has progressively crossed widely recognized red lines without paying a significant price. Short of the use of its weapons, the most serious red line remaining is the export of its weapons or its plutonium. North Korea also has a full range of nuclear technologies and skills that it can market to states or nonstate groups with nuclear-weapon aspirations. The highest priority goal of the six-party agreement must be to prevent such exports.

Whereas Pyongyang may be tempted to market its nuclear products for money alone, much as it does its conventional weapons, missiles, drugs, narcotics, and counterfeit currency, the risk of doing so would be high, probably too high. On the other hand, it is more plausible that North Korea could seek partners that have money and could effectively help to constrain the United States from taking actions against it. In other words, it may seek to strike a deal that would help ensure regime survival and yield much-needed revenues.

To be sure, nuclear commerce of any kind poses significant risk for Pyongyang. The transit of nuclear weapons and plutonium may be interdicted. Detonation of a nuclear device, either an as-built North Korean nuclear weapon or a crude, improvised nuclear device, is very likely to be traced back and would be guaranteed to elicit a strong response from the international community, including military action that would surely result in regime change. For these reasons, North Korea is unlikely to sell or outsource a nuclear weapon. It is also unlikely to simply sell its plutonium, although a grander bargain may be possible as outlined below. It may be much more likely to

put its nuclear technologies and expertise on the market because it could claim these to be civilian transactions.

A Potential North Korean-Iranian Nuclear Deal

Iran appears to be North Korea's most likely customer or partner for nuclear technologies. Each side has what the other needs. Despite protestations to the contrary, Iran seems to be on a determined, albeit slow, path to nuclear weapons. It began its covert uranium-enrichment program nearly 20 years ago but has only recently publicly demonstrated its ability to produce low-enriched uranium. Iranian officials have said that the small quantities of HEU that have been discovered at its facilities are not the result of domestic capabilities, but rather of importing "contaminated" Pakistani equipment. In any case, the amount that has been discovered would not suffice for building nuclear weapons.

Obtaining 10 to 20 kilograms of plutonium from North Korea, however, would catapult it into nuclear-weapon status. In addition, a longer-term deal could assist Iran with a uranium-based nuclear-weapon development effort. As indicated above, Pyongyang has front-end fuel-cycle capabilities that could aid most of Iran's uranium-enrichment activities from mining through the production of uranium hexafluoride. It has hands-on experience in uranium metallurgy that would prove useful in fabrication of HEU weapons. It has the requisite capabilities and facilities for plutonium separation from spent fuel, which would be useful once Iran completes its heavy water reactor. It has some nuclear-weapon design experience, non-nuclear-explosive test experience, and limited nuclear test experience, all of which could provide valuable assistance to a fledgling nuclear-weapon state.

Iran has money and oil, just what Pyongyang needs most. The two countries have long-standing collaborations in ballistic missiles dating back to the Iran-Iraq War. In addition to missile sales, North Korea helped Iran establish a missile assembly facility and provided the required technical documentation for future production.^[13] Key engineers and military personnel were exchanged on a regular basis, and missile cooperation continues today.^[14] If the six-party agreement falls through, Iran could help finance an expanded North

Korean nuclear weapons program—for example, the completion of its large reactors, in exchange for nuclear assistance, just as it had done with the North Korean missile program in the mid-1980s in exchange for ballistic missile technology. Alternatively, even additionally, Iran could provide North Korea with heavily discounted rates for crude oil.

The sale of plutonium represents the gravest and most immediate threat. During the visit to Yongbyon, North Korean technical specialists demonstrated the ability to produce plutonium metal or plutonium oxide powder, the two most likely forms for transport. In fact, Hecker was allowed to hold a sealed glass jar with a 200-gram casting of alloyed plutonium metal. Alloying plutonium with a few atomic percent gallium or aluminum makes it easier to cast and produces a more-corrosion-resistant surface.

Plutonium oxide powder could be shipped using methods similar to some of the methods used to transport heroin.^[15] Unless it is packaged properly, however, plutonium oxide powder is dangerous to handle because of the health risk of inhalation or ingestion. Also, additional processing is required to convert the oxide back to weapons-usable metal. A safer and more convenient choice is to alloy the plutonium and cast it into pucks of moderate weight. North Korea could easily produce pucks that weigh one kilogram and can fit in the palm of one's hand (approximately 6.5 centimeters in diameter and 2 centimeters thick). Roughly six such pucks are required for a simple nuclear bomb.

North Korea is unlikely to encounter serious hurdles if it were to ship plutonium to Iran, considering the level of current commerce and exchange. Detecting such metal pucks would be very difficult. Plutonium decays principally by the emission of alpha particles, which are easily stopped by plastic, a glass container, or a cardboard box. Its gamma rays and neutrons are not as easily stopped, but they can be quite effectively shielded with lead and B-poly plastic, respectively. North Korea has extensive experience in shipping legitimate and illegal goods to many states, including Iran. It had an especially active trade with Pakistan, using shipping routes by sea and by land and air through China. Sea routes are the least attractive because of the threat of maritime interception under the Proliferation

Security Initiative (PSI). By contrast, the likelihood of detection and interdiction by PSI through land routes is virtually zero.

North Korea may view a nuclear deal that combines near-term sale of some of its plutonium combined with long-term transfer of nuclear technologies and expertise to Iran to yield sufficient benefit to warrant the risk. Unlike a sale to terrorists or organized crime, nuclear cooperation with Iran would be more difficult to detect and deter. A nuclear deal could allow Iran quickly to produce a few nuclear weapons and, even without using them, shift the regional security balance in the Middle East in its favor. If North Korean-fueled Iranian weapons were not detonated, it would be difficult to take actions against Pyongyang. If a deal were to deliver plutonium to Iran, however, the likelihood of it winding up in the hands of terrorists might increase dramatically, given Iran's much closer ties to such groups.

To be sure, some scholars argue that Iran, like North Korea, may be seeking nuclear weapons in the interest of self-preservation.^[16] If this assessment were correct, then Iran would also face disincentives for passing nuclear weapons to nonstate actors. Yet, given Iran's much closer ties to terrorists, any potential deal to deliver plutonium to Iran would still significantly increase the likelihood of plutonium winding up in the hands of such groups. Nuclear weapons experts generally agree that terrorists would face significant challenges in constructing and detonating a rudimentary nuclear device that could devastate a big city. Once terrorists have access to sufficient fissile material, these roadblocks would not be insurmountable.^[17]

Preventing a North Korean-Iranian Nuclear Deal

The recent six-party agreement makes a North Korean-Iranian nuclear deal less likely. It removes some of the principal incentives for North Korea to strike such a deal and offers a much lower risk option within the six-party process for Pyongyang to get what it wants. However, several steps should be taken now to reduce the likelihood of a North Korean-Iranian nuclear deal regardless of the eventual outcome of the six-party agreement. First, a clear message must be sent to North Korea that the export of plutonium or other technical assistance to further an Iranian nuclear weapons program

would represent a real red line. Specifically, if a nuclear bomb fueled by North Korean plutonium is detonated anywhere in the world, it will elicit a massive military response that will destroy the regime of Kim Jong Il. Pyongyang must be warned that once plutonium leaves its borders, it loses control but retains responsibility because that plutonium will reveal its unique fingerprint. Hence, North Korea will not be able to escape the consequences of the misuse of that material. Once in Iran, the potential pathways for the plutonium from the government minders to potential terrorist groups are frighteningly many. To date, the response to the missile tests and nuclear test has brought nearly universal condemnation, but few strict reprisals.

China and South Korea are particularly reluctant to take strong measures because they view the threat posed by North Korea's nuclear program and how it should be countered quite differently than it is viewed in the United States. Yet, a nuclear bomb fueled with North Korean plutonium detonated anywhere in the world will be a global catastrophe. In addition to the massive loss of life in the affected country, the political and economic instabilities that would follow the nuclear detonation and the retaliatory military response will disrupt global commerce and life. It is in China's self interest to help prevent the transport of North Korean plutonium and nuclear technologies across its land or air space.

Second, although North Korea has agreed to shut down its nuclear facilities and allow IAEA inspectors to return, it has not given any indication of when the weapons would be eliminated and what will be done with the plutonium. To avoid the potential export of plutonium, it is imperative that steps are taken as quickly as possible to secure its plutonium inventory in a verifiable manner.

Finally, Pyongyang must agree to abandon the construction of the 50-megawatt reactor at the Yongbyon construction site and at other sites that have been fabricating the reactor core and other components. Permanently disabling this reactor will prevent the ten-fold scale up of plutonium production and, in turn, greatly reduce the risk of plutonium export.

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ENDNOTES

1. On October 21, 1994, the United States and North Korea signed the Agreed Framework, calling on Pyongyang to freeze operation and construction of nuclear reactors and related facilities suspected of being part of a covert nuclear weapons program in exchange for two light-water nuclear power reactors. The agreement also called on the United States to supply North Korea with fuel oil pending construction of the reactors. An international consortium called the Korean Peninsula Energy Development Organization was formed to implement the construction of the reactors. The Agreed Framework ended an 18-month crisis during which North Korea announced its intention to withdraw from the nuclear Nonproliferation Treaty.

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